United Nations S/2017/768

Security Council

Distr.: General
11 September 2017

Original: English

# Letter dated 11 September 2017 from the Permanent Representative of the United States of America to the United Nations addressed to the President of the Security Council

The United States Mission to the United Nations requests that the Conventional Arms Dual-Use Control List (see annex) be circulated as a document of the Security Council.

(*Signed*) Nikki **Haley**
Ambassador

17-15773 (E) 120917

Please recycle

**Annex to the letter dated 11 September 2017 from the Permanent Representative of the United States of America to the United Nations addressed to the President of the Security Council**

# Expansion proposal for conventional arms-related dual-use items, 8 September 2017

## Special materials and related items

## Systems, equipment and components

1. Seals, gaskets, sealants or fuel bladders, made from more than 50 per cent by weight of any of the Fluorinated polyimides or Fluorinated phosphazene elastomers.

2. Manufactures of non-"fusible" aromatic polyimides in film, sheet, tape or ribbon.

3. Protective and detection equipment and components, not specially designed for military use, as follows:

   a. Full face masks, filter canisters, protective suits, gloves and shoes, detection systems and decontamination equipment specially designed or modified for defence against any of the following:

      1. "Biological agents";

      2. 'Radioactive materials'; or

      3. Chemical warfare (CW) agents.

4. Equipment and devices, specially designed to initiate charges and devices containing "energetic materials", by electrical means, as follows:

   a. Explosive detonator firing sets designed to drive explosive detonators specified by 1.A.7.b.

   b. Electrically driven explosive detonators as follows:

      1. Exploding bridge (EB);

      2. Exploding bridge wire (EBW);

      3. Slapper; or

      4. Exploding foil initiators (EFI).

   *Technical notes*

   *1. The word initiator or igniter is sometimes used in place of the word detonator.*

   *2. For the purpose of 1.A.5.b. the detonators of concern all utilise a small electrical conductor (bridge, bridge wire, or foil) that explosively vaporises when a fast, high-current electrical pulse is passed through it. In non-slapper types, the exploding conductor starts a chemical detonation in a contacting high explosive material such as PETN (pentaerythritoltetranitrate). In slapper detonators, the explosive vaporisation of the electrical conductor drives a flyer or slapper across a gap, and the impact of the slapper on an explosive starts a chemical detonation. The slapper in some designs is driven by magnetic force. The*

*term exploding foil detonator may refer to either an EB or a slapper-type detonator.*

5. Charges, devices and components, as follows:

   a. 'Shaped charges';

   b. Linear shaped cutting;

   c. Detonating cord with explosive core; or

   d. Cutters, and other severing tools.

## Test, inspection and production equipment

1. Equipment for the production or inspection of "composite" structures or laminates or "fibrous or filamentary materials" as follows, and specially designed components and accessories therefor:

   a. 'Tow-placement machines', specially designed for the manufacture of "composite" structures.

2. Equipment for producing metal alloys, metal alloy powder or alloyed material.

3. Tools, dies, moulds or fixtures, for "superplastic forming" or "diffusion bonding" titanium, aluminium or their alloys.

## Materials

*Technical note*

*Metals and alloys*

*Unless provision to the contrary is made, the words 'metals' and 'alloys' cover crude and semi-fabricated forms, as follows:*

*Crude forms*

*Anodes, balls, bars (including notched bars and wire bars), billets, blocks, blooms, briquettes, cakes, cathodes, crystals, cubes, dice, grains, granules, ingots, lumps, pellets, pigs, powder, rondelles, shot, slabs, slugs, sponge, sticks.*

1. Materials specially designed for use as absorbers of electromagnetic waves, or intrinsically conductive polymers, as follows:

   a. Intrinsically conductive polymeric materials based on any of the following polymers:

      1. Polyaniline;

      2. Polypyrrole;

      3. Polythiophene;

      4. Poly phenylene-vinylene; or

      5. Poly thienylene-vinylene.

2. "Superconductive" "composite" conductors.

3. "Fibrous or filamentary materials" as follows:

   a. Organic "fibrous or filamentary materials", having all of the following:

      1. "Specific modulus" exceeding $12.7 \times 10^6$ m; and

2. "Specific tensile strength" exceeding $23.5 \times 10^4$ m;

*Note 1.C.10.a. does not apply to polyethylene.*

b. Carbon "fibrous or filamentary materials", having all of the following:

1. "Specific modulus" exceeding $14.65 \times 10^6$ m; and

2. "Specific tensile strength" exceeding $26.82 \times 10^4$ m;

c. Inorganic "fibrous or filamentary materials", having all of the following:

1. "Specific modulus" exceeding $2.54 \times 10^6$ m; and

2. Melting, softening, decomposition or sublimation point exceeding 1,922 K (1,649°C) in an inert environment.

## Software

1. "Software" specially designed or modified for the "development", "production" or "use" of equipment specified above.

2. "Software" for the "development" of material specified above.

3. "Software" specially designed or modified to enable non-listed equipment to perform the functions of any equipment specified above.

## Technology

1. "Technology" for the "development", "production" or "use" of equipment materials or software specified above.

# Materials processing equipment

## Systems, equipment and components

1. Anti-friction bearings and bearing systems, as follows, and components therefor:

   *Note 2.A.1. does not apply to balls with tolerances specified by the manufacturer in accordance with ISO 3290 as grade 5 or worse.*

   a. Ball bearings and solid roller bearings, having all tolerances specified by the manufacturer in accordance with ISO 492 Tolerance Class 4 (or national equivalents), or better, and having both 'rings' and 'rolling elements', made from monel or beryllium;

      *Technical notes*

      *1. 'Ring' — annular part of a radial rolling bearing incorporating one or more raceways (ISO 5593:1997).*

      *2. 'Rolling element' — ball or roller which rolls between raceways (ISO 5593:1997).*

   c. Active magnetic bearing systems.

## Test, inspection and production equipment

1. Machine tools and any combination thereof, for removing (or cutting) metals, ceramics or "composites", which, according to the manufacturer's technical specification, can be equipped with electronic devices for "numerical control":

   a. Machine tools for grinding having any of the following:

      1. Three or more axes which can be coordinated simultaneously for "contouring control"; or

      2. Five or more axes which can be coordinated simultaneously for "contouring control".

   b. Machine tools for removing metals, ceramics or "composites", having all of the following:

      1. Removing material by means of any of the following:

         a. Water or other liquid jets, including those employing abrasive additives;

         b. Electron beam; or

         c. "Laser" beam; and

      2. At least two rotary axes that can be coordinated simultaneously for "contouring control".

2. Numerically controlled optical finishing machine tools equipped for selective material removal to produce non-spherical optical surfaces.

3. Hot "isostatic presses" having all of the following, and specially designed components and accessories therefor:

   a. A controlled thermal environment within the closed cavity.

4. Equipment specially designed for the deposition, processing and in-process control of inorganic overlays, coatings and surface modifications, as follows:

   a. Chemical vapour deposition (CVD) production equipment;

   b. Ion implantation production equipment having beam currents of 5 mA or more;

   c. Electron beam physical vapour deposition (EB-PVD) production equipment;

   d. Plasma spraying production equipment operating at reduced pressure controlled atmosphere;

   e. Sputter deposition production equipment;

   f. Cathodic arc deposition production equipment; or

   g. Ion plating production equipment.

5. Dimensional inspection or measuring systems, equipment and "electronic assemblies", as follows:

   a. Computer controlled or "numerically controlled" Coordinate Measuring Machines (CMM);

   b. Linear and angular displacement measuring instruments, as follows:

      1. 'Linear displacement' measuring instruments having any of the following:

         a. Non-contact type measuring systems;

         b. Linear Variable Differential Transformer (LVDT) systems;

         c. Measuring systems containing a "laser";

         d. "Electronic assemblies" specially designed to provide feedback capability in systems specified by 2.B.6.;

      2. Angular displacement measuring instruments.

      *Note* *b.2. does not apply to optical instruments, such as autocollimators, using collimated light (e.g., "laser" light) to detect angular displacement of a mirror.*

   c. Equipment for measuring surface roughness (including surface defects), by measuring optical scatter.

6. "Robots" having any of the following characteristics and specially designed controllers and "end-effectors" therefor:

   a. Capable in real time of full three-dimensional image processing or full three-dimensional 'scene analysis' to generate or modify "programs" or to generate or modify numerical program data;

      *Technical note*

      *The 'scene analysis' limitation does not include approximation of the third dimension by viewing at a given angle, or limited grey scale interpretation for the perception of depth or texture for the approved tasks (2 1/2 D).*

   b. Specially designed to comply with national safety standards applicable to potentially explosive munitions environments;

   c. Specially designed or rated as radiation-hardened; or

d. Specially designed to operate at altitudes exceeding 30,000 m.

7. Assemblies or units, specially designed for machine tools, or dimensional inspection or measuring systems and equipment, as follows:

a. Linear position feedback units;

b. Rotary position feedback units; or

c. "Compound rotary tables" and "tilting spindles", for use with machine tools.

8. Spin-forming machines and flow-forming machines, which, according to the manufacturer's technical specification, can be equipped with "numerical control" units or a computer control and having all of the following:

a. Three or more axes which can be coordinated simultaneously for "contouring control".

*Technical note*

*For the purpose of machines combining the function of spin-forming and flow-forming are regarded as flow-forming machines.*

## Software

1. "Software" specially designed or modified for the "development", "production" or "use" of equipment specified above; or

2. "Software" specially designed or modified to allow non-listed equipment to function as equipment specified above.

## Technology

1. "Technology" for the "development", "production" or "use" of equipment or "software" specified above.

# Electronics

## Systems, equipment and components

1. Electronic items as follows:

a. General purpose integrated circuits, as follows:

*Note 1 The status of wafers (finished or unfinished), in which the function has been determined, is to be evaluated against the parameters of 3.A.1.a.*

*Note 2 Integrated circuits include the following types:*

- *"Monolithic integrated circuits";*
- *"Hybrid integrated circuits";*
- *"Multichip integrated circuits";*
- *"Film type integrated circuits", including silicon-on-sapphire integrated circuits;*
- *"Optical integrated circuits";*
- *"Three dimensional integrated circuits";*
- *"Monolithic Microwave Integrated Circuits" ("MMICs").*

1. Integrated circuits designed or rated as radiation hardened.

2. "Microprocessor microcircuits", "microcomputer microcircuits", microcontroller microcircuits, storage integrated circuits manufactured from a compound semiconductor, analogue-to-digital converters, integrated circuits that contain analogue-to-digital converters and store or process the digitized data, digital-to-analogue converters, electro-optical or "optical integrated circuits" designed for "signal processing", field programmable logic devices, custom integrated circuits for which either the function is unknown or the status of the equipment in which the integrated circuit will be used is unknown, Fast Fourier Transform (FFT) processors, Electrical Erasable Programmable Read-Only Memories (EEPROMs), flash memories, Static Random-Access Memories (SRAMs) or Magnetic Random Access Memories (MRAMs).

3. Electro-optical and "optical integrated circuits", designed for "signal processing".

4. Field programmable logic.

5. Neural network integrated circuits.

6. Custom integrated circuits for which the function is unknown, or the status of the equipment in which the integrated circuits will be used is unknown to the manufacturer.

7. Direct Digital Synthesizer (DDS) integrated.

b. Microwave or millimetre wave items, as follows:

1. a. Travelling-wave 'vacuum electronic devices', pulsed or continuous wave;

b. Crossed-field amplifier 'vacuum electronic devices';

c. Thermionic cathodes designed for 'vacuum electronic devices';

d. 'Vacuum electronic devices' with the capability to operate in a 'dual mode'.

*Technical note*

*'Dual mode' means the 'vacuum electronic device' beam current can be intentionally changed between continuous-wave and pulsed mode operation by use of a grid and produces a peak pulse output power greater than the continuous-wave output power.*

2. "Monolithic Microwave Integrated Circuit" ("MMIC") amplifiers;

3. Discrete microwave transistors;

4. Microwave solid state amplifiers and microwave assemblies/modules containing microwave solid state amplifiers;

5. Electronically or magnetically tunable band-pass or band-stop filters;

6. Converters and harmonic mixers;

7. Microwave power amplifiers containing 'vacuum electronic devices';

8. Microwave Power Modules (MPMs) consisting of, at least, a travelling-wave 'vacuum electronic device', a "Monolithic Microwave Integrated Circuit" ("MMIC") and an integrated electronic power conditioner;

9. Oscillators or oscillator assemblies;

10. "Frequency synthesizer" "electronic assemblies";

11. 'Transmit/receive modules', 'transmit/receive MMICs', 'transmit modules', and 'transmit MMICs';

c. Acoustic wave devices as follows and specially designed components therefor:

1. Surface acoustic wave and surface skimming (shallow bulk) acoustic;

2. Bulk (volume) acoustic wave;

3. Acoustic-optic "signal processing";

d. Electronic devices and circuits containing components, manufactured from "superconductive" materials,

e. High energy devices as follows:

1. 'Cells' as follows:

a. 'Primary cells' having an 'energy density' exceeding 550 Wh/kg at 20°C;

b. 'Secondary cells' having an 'energy density' exceeding 350 Wh/kg at 20°C;

*Technical notes*

*1. For the purpose of high energy devices, 'energy density' (Wh/kg) is calculated from the nominal voltage*

*multiplied by the nominal capacity in ampere-hours (Ah) divided by the mass in kilograms. If the nominal capacity is not stated, energy density is calculated from the nominal voltage squared then multiplied by the discharge duration in hours divided by the discharge load in Ohms and the mass in kilograms.*

*2. For the purpose of high energy devices, a 'cell' is defined as an electrochemical device, which has positive and negative electrodes, an electrolyte, and is a source of electrical energy. It is the basic building block of a battery.*

*3. For the purpose of high energy devices, a 'primary cell' is a 'cell' that is not designed to be charged by any other source.*

*4. For the purpose of high energy devices, a 'secondary cell' is a 'cell' that is designed to be charged by an external electrical source.*

*Note High energy devices do not apply to batteries, including single-cell batteries.*

2. High energy storage capacitors;

3. "Superconductive" electromagnets and solenoids, specially designed to be fully charged or discharged in less than one second:

*Note Above item does not apply to "superconductive" electromagnets or solenoids specially designed for Magnetic Resonance Imaging (MRI) medical equipment.*

4. Solar cells, cell-interconnect-coverglass (CIC) assemblies, solar panels, and solar arrays, which are "space-qualified", having a minimum average efficiency exceeding 20 per cent at an operating temperature of 301 K (28°C) under simulated 'AM0' illumination with an irradiance of 1,367 Watts per square meter ($W/m^2$);

*Technical note*

*'AM0', or 'Air Mass Zero', refers to the spectral irradiance of sun light in the earth's outer atmosphere when the distance between the earth and sun is one astronomical unit (AU).*

f. Rotary input type absolute position encoders having an "accuracy" equal to or less (better) than 1.0 second of arc and specially designed encoder rings, discs or scales therefor;

g. Solid-state pulsed power switching thyristor devices and 'thyristor modules', using either electrically, optically, or electron radiation controlled switch methods;

h. Solid-state power semiconductor switches, diodes, or 'modules', having all of the following:

1. Rated for a maximum operating junction temperature greater than 488 K (215°C);

2. Repetitive peak off-state voltage (blocking voltage) exceeding 300 V; and

3. Continuous current greater than 1 A;

*Note 1 Repetitive peak off-state voltage in the above item includes drain to source voltage, collector to emitter voltage, repetitive peak reverse voltage and peak repetitive off-state blocking voltage.*

2. General purpose "electronic assemblies", modules and equipment, as follows:

   a. Recording equipment and oscilloscopes, as follows:

      1. Digital data recorders;

      2. Real-time oscilloscopes having a vertical root-mean-square (rms) noise voltage of less than 2 per cent of full-scale at the vertical scale setting that provides the lowest noise value for any input 3dB bandwidth of 60 GHz or greater per channel;

   b. "Signal analysers";

   c. Signal generators;

   d. Network analysers having any of the following:

   e. Microwave test receivers;

   f. Atomic frequency;

## Test, inspection and production equipment

1. Equipment for the manufacturing of semiconductor devices or materials, as follows and specially designed components and accessories therefor:

   a. Equipment designed for ion implantation;

   b. Lithography and Imprint lithography equipment;

   c. 1. Equipment specially designed for mask using deflected focused electron beam, ion beam or "laser" beam;

      2. Equipment designed for device processing using direct writing methods;

   d. Masks and reticles, designed for integrated circuits;

2. Test equipment specially designed for testing finished or unfinished semiconductor and microwave devices.

## Materials

1. Hetero-epitaxial materials consisting of a "substrate" having stacked epitaxially grown multiple layers.

2. Resist materials designed for semiconductor lithography and "substrates".

3. Organo-inorganic compounds:

   a. Organo-metallic compounds of aluminium, gallium or indium, having a purity (metal basis) better than 99.999 per cent;

   b. Organo-arsenic, organo-antimony and organo-phosphorus compounds, having a purity (inorganic element basis) better than 99.999 per cent.

4. Hydrides of phosphorus, arsenic or antimony, having a purity better than 99.999 per cent, even diluted in inert gases or hydrogen.

*Note* *Above item does not apply to hydrides containing 20 per cent molar or more of inert gases or hydrogen.*

5. Silicon carbide (SiC), gallium nitride (GaN), aluminium nitride (AlN) or aluminium gallium nitride (AlGaN) semiconductor "substrates", or ingots, boules, or other preforms of those materials, having resistivities greater than 10,000 ohm-cm at 20°C.

6. "Substrates" specified in #5 with at least one epitaxial layer of silicon carbide, gallium nitride, aluminium nitride or aluminium gallium nitride.

## Software

1. "Software" specially designed for the "development", "production" or "use" of equipment specified above.

2. "Software" specially designed or modified to allow non-listed equipment to function as equipment specified above.

## Technology

1. "Technology" for the "development", "production" or "use" of equipment or materials specified above.

## Sensors and "lasers"

### Optical sensors

1. Optical sensors or equipment and components therefor, as follows:

   a. Special support components for optical sensors, as follows:

      1. "Space-qualified" cryocoolers;

      2. Non-"space-qualified" cryocoolers having a cooling source temperature below 218 K (-55°C)

      3. Optical sensing fibres specially fabricated either compositionally or structurally, or modified by coating, to be acoustically, thermally, inertially, electromagnetically or nuclear radiation sensitive.

### Cameras

1. Cameras, systems or equipment, and components therefor, as follows:

   a. Instrumentation cameras and specially designed components therefor, as follows:

      *Note* *Instrumentation cameras, specified above, with modular structures should be evaluated by their maximum capability, using plug-ins available according to the camera manufacturer's specifications.*

      1. High-speed cinema recording cameras using any film format from 8 mm to 16 mm inclusive, in which the film is continuously advanced throughout the recording period, and that are capable of recording at framing rates exceeding 13,150 frames/s;

         *Note* *Above item does not apply to cinema recording cameras designed for civil purposes.*

      2. Mechanical high speed cameras;

      3. Mechanical or electronic streak cameras;

      4. Electronic framing cameras;

      5. Electronic cameras having all of the following:

         a. An electronic shutter speed (gating capability) of less than 1 µs per full frame; and

         b. A read out time allowing a framing rate of more than 125 full frames per second;

      6. Plug-ins having all of the following characteristics:

         a. Specially designed for instrumentation cameras which have modular structures;

         b. Imaging cameras as follows:

            *Note* *Above item does not apply to television or video cameras, specially designed for television broadcasting.*

            1. Video cameras incorporating solid state sensors, following;

            2. Scanning cameras and scanning camera systems;

            3. Imaging cameras incorporating image intensifier tubes;

4. Imaging cameras incorporating "focal plane arrays".

## Optics

1. Optical equipment and components, as follows:
   a. Optical mirrors (reflectors) as follows:
      1. "Deformable mirrors";
      2. Lightweight monolithic mirrors;
      3. Lightweight "composite" or foam mirror;
      4. Mirrors specially designed for beam steering mirror stages;
   b. Optical components made from zinc selenide (ZnSe) or zinc sulphide (ZnS);
   c. "Space-qualified" components for optical systems.

## Lasers

1. "Lasers", components and optical equipment, as follows:
   a. Non-"tunable" continuous wave "(CW) lasers;"
   b. "Tunable" "lasers";
   c. Other Semiconductor "lasers";

   *Note 1 Includes semiconductor "lasers" having optical output connectors (e.g. fibre optic pigtails).*

   *Note 2 The status of semiconductor "lasers" specially designed for other equipment is determined by the status of the other equipment.*

      1. a. Individual single-transverse mode semiconductor "lasers";
         b. Individual, multiple-transverse mode semiconductor "lasers";
         c. Individual semiconductor "laser" 'bars';
         d. Semiconductor "laser" 'stacked arrays' (two-dimensional arrays);
      2. "Chemical lasers" as follows:
         a. Hydrogen Fluoride (HF) "lasers";
         b. Deuterium Fluoride (DF) "lasers";
         c. "Transfer lasers" as follows:
            1. Oxygen Iodine ($O_2$-I) "lasers";
            2. Deuterium Fluoride-Carbon dioxide (DF-$CO_2$) "lasers";
      3. 'Non-repetitive pulsed' Nd: glass "lasers" having any of the following:
         a. "Pulse duration" not exceeding 1 µs and output energy exceeding 50 J per pulse; or
         b. "Pulse duration" exceeding 1 µs and output energy exceeding 100 J per pulse;

d. Components as follows:

1. Mirrors cooled either by "active cooling" or by heat pipe cooling;

2. Optical mirrors or transmissive or partially transmissive optical or electro-optical components, other than fused tapered fibre combiners and Multi-Layer Dielectric gratings (MLDs), specially designed for use with specified "lasers";

3. Fibre "laser" components;

## Magnetic and electric field sensors

### Magnetometers

1. "Magnetometers", "magnetic gradiometers", "intrinsic magnetic gradiometers", underwater electric field sensors, "compensation systems" and specially designed components therefor.

### Gravimeters

1. Gravity meters (gravimeters) and gravity gradiometers.

### Radar

1. Radar systems, equipment and assemblies.

2. "Laser" radar or Light Detection and Ranging (LIDAR) equipment.

## Test, inspection and production equipment

### Optics

1. Optical equipment as follows:

a. Equipment for measuring absolute reflectance to an "accuracy" of equal to or better than 0.1 per cent of the reflectance value;

b. Equipment other than optical surface scattering measurement equipment, having an unobscured aperture of more than 10 cm, specially designed for the non-contact optical measurement of a non-planar optical surface figure (profile) to an "accuracy" of 2 nm or less (better) against the required profile.

*Note: Above item does not apply to microscopes.*

### Gravimeters

1. Equipment to produce, align and calibrate land-based gravity meters.

### Radar

1. Pulse radar cross-section measurement.

## Materials

### Optical sensors

1. Optical sensor materials as follows:

   a. Elemental tellurium (Te) of purity levels of 99.9995 per cent or more;

   b. Single crystals (including epitaxial wafers) of any of the following:

      1. Cadmium zinc telluride (CdZnTe);

      2. Cadmium telluride (CdTe) of any purity level; or

      3. Mercury cadmium telluride (HgCdTe) of any purity level.

### Optics

1. Optical materials as follows:

   a. Zinc selenide (ZnSe) and zinc sulphide (ZnS) "substrate blanks";

   b. Electro-optic materials and non-linear optical materials, as follows:

      1. Potassium titanyl arsenate (KTA) (CAS 59400-80-5);

      2. Silver gallium selenide (AgGaSe2, also known as AGSE) (CAS 12002-67-4);

      3. Thallium arsenic selenide (Tl3AsSe3, also known as TAS) (CAS 16142-89-5);

      4. Zinc germanium phosphide (ZnGeP2, also known as ZGP, zinc germanium biphosphide or zinc germanium diphosphide); or

      5. Gallium selenide (GaSe) (CAS 12024-11-2).

   c. "Substrate blanks" of silicon carbide or beryllium beryllium (Be-Be) deposited materials;

   d. Glass, including fused silica, phosphate glass, fluorophosphate glass, zirconium fluoride (ZrF4) (CAS 7783-64-4) and hafnium fluoride (HfF4) (CAS 13709-52-9);

   e. Synthetically produced diamond material.

### Lasers

1. "Laser" materials as follows:

   a. Synthetic crystalline "laser" host material; or

   b. Rare-earth-metal doped double-clad fibres.

### Software

1. "Software" specially designed for the "development", "production" or "use" of equipment specified above.

2. "Software" specially designed or modified to allow non-listed equipment to function as equipment specified above.

## Technology

1. "Technology for the "development", "production or "use" of equipment, materials or software specified above.

# Navigation and avionics

## Systems, equipment and components

1. Accelerometers as follows and specially designed components therefor:

   a. Linear accelerometers having any of the following:

      1. Specified to function at linear acceleration levels having a "scale factor" "repeatability" of less (better) than 1,250 ppm over a period of one year; or

      2. Designed for use in inertial navigation or guidance systems;

   b. Angular or rotational accelerometers, specified to function at linear acceleration.

2. Gyros or angular rate sensors, having any of the following and specially designed components therefor:

   a. Specified to function at linear acceleration having the following:

      1. A "bias" "stability" of less (better) than 0.5 degree per hour, when measured in a 1 g environment over a period of one month, and with respect to a fixed calibration value.

3. 'Inertial measurement equipment or systems', having any of the following:

   *Note 1 'Inertial measurement equipment or systems' incorporate accelerometers or gyroscopes to measure changes in velocity and orientation in order to determine or maintain heading or position without requiring an external reference once aligned. 'Inertial measurement equipment or systems' include:*

   *– Attitude and Heading Reference Systems (AHRSs);*

   *– Gyrocompasses;*

   *– Inertial Measurement Units (IMUs);*

   *– Inertial Navigation Systems (INSs);*

   *– Inertial Reference Systems (IRSs);*

   *– Inertial Reference Units (IRUs).*

   a. Designed for "aircraft", land vehicles or vessels, providing position without the use of 'positional aiding references', and having any of the following "accuracies" subsequent to normal alignment:

      1. 0.8 nautical miles per hour (nm/hr) "Circular Error Probable" ("CEP") rate or less (better);

      2. 0.5 per cent distance travelled "CEP" or less (better); or

      3. Total drift of 1 nautical mile "CEP" or less (better) in a 24 hour period;

   b. Designed for "aircraft", land vehicles or vessels, with an embedded 'positional aiding reference' and providing position after loss of all 'positional aiding references' for a period of up to 4 minutes, having an "accuracy" of less (better) than 10 meters "CEP";

*Technical note*

*Refers to systems in which 'inertial measurement equipment or systems' and other independent 'positional aiding references' are built into a single unit (i.e., embedded) in order to achieve improved performance.*

c. Designed for "aircraft", land vehicles or vessels, providing heading or True North determination;

d. Providing acceleration measurements or angular rate measurements, in more than one dimension.

4. 'Star trackers' and components therefor.

*Technical note*

*'Star trackers' are also referred to as stellar attitude sensors or gyro-astro compasses.*

5. Global Navigation Satellite Systems (GNSS) receiving equipment having any of the following and specially designed components therefor.

6. Airborne altimeters operating at frequencies other than 4.2 to 4.4 GHz inclusive and having any of the following:

a. "Power management"; or

b. Using phase shift key modulation.

## Test, inspection and production equipment

1. Test, calibration or alignment equipment, specially designed for equipment specified by the section above.

2. Equipment specially designed to characterize mirrors for ring "laser" gyros, or less (better).

3. Equipment specially designed for the "production" of equipment specified by above.

*Note* *Including:*

- *Gyro tuning test stations;*
- *Gyro dynamic balance stations;*
- *Gyro run-in/motor test stations;*
- *Gyro evacuation and fill stations;*
- *Centrifuge fixtures for gyro bearings;*
- *Accelerometer axis align stations;*
- *Fibre optic gyro coil winding machines.*

## Software

1. "Software" specially designed or modified for the "development", "production" or "use" of equipment specified above.

2. "Software" specially designed or modified to allow non-listed equipment to function as equipment specified above.

3. "Source code" for the operation or maintenance of equipment specified above.

4. Computer-Aided-Design (CAD) "software" specially designed for the "development" of "active flight control systems", helicopter multi-axis fly-by-wire or fly-by-light controllers or helicopter "circulation controlled anti-torque or circulation-controlled direction control systems".

## Technology

1. "Technology" for the "development", "production" and "use" of equipment or "software", specified above.

# Marine

## Systems, equipment and components

1. Marine systems, equipment and components, as follows:

   a. Systems, equipment and components, specially designed or modified for submersible vehicles and designed to operate at depths exceeding 1,000 m, as follows:

      1. Pressure housings or pressure hulls with a maximum inside chamber diameter exceeding 1.5 m;

      2. Direct current propulsion motors or thrusters;

      3. Umbilical cables, and connectors therefor, using optical fibre and having synthetic strength members;

      4. Components manufactured from material;

         *Technical note*

         *The objective of the above item should not be defeated by the export of 'syntactic foam' designed for underwater use and having all of the following: a. Designed for marine depths exceeding 1,000 m and a density less than 561 kg/m$^3$ when an intermediate stage of manufacture has been performed and it is not yet in its final component form.*

   b. Systems specially designed or modified for the automated control of the motion of submersible vehicles specified above, using navigation data, having closed loop servo-controls and having any of the following:

      1. Enabling a vehicle to move within 10 m of a predetermined point in the water column;

      2. Maintaining the position of the vehicle within 10 m of a predetermined point in the water column; or

      3. Maintaining the position of the vehicle within 10 m while following a cable on or under the seabed;

   c. Fibre optic pressure hull penetrators;

   d. "Robots" specially designed for underwater use, controlled by using a dedicated computer and having any of the following:

      1. Systems that control the "robot" using information from sensors which measure force or torque applied to an external object, distance to an external object, or tactile sense between the "robot" and an external object; or

      2. The ability to exert a force of 250 N or more or a torque of 250 Nm or more and using titanium based alloys or "composite" "fibrous or filamentary materials" in their structural members;

   e. 1. Stirling cycle engine air independent power systems having all of the following:

         a. Devices or enclosures, specially designed for underwater noise reduction in frequencies below 10 kHz, or special mounting devices for shock mitigation; and

b. Specially designed exhaust systems which discharge the products of combustion against a pressure of 100 kPa or more;

f. 1. Noise reduction systems designed for use on vessels of 1,000 tonnes displacement or more, as follows:

a. Systems that attenuate underwater noise at frequencies below 500 Hz and consist of compound acoustic mounts for the acoustic isolation of diesel engines, diesel generator sets, gas turbines, gas turbine generator sets, propulsion motors or propulsion reduction gears, specially designed for sound or vibration isolation and having an intermediate mass exceeding 30% of the equipment to be mounted;

b. 'Active noise reduction or cancellation systems' or magnetic bearings, specially designed for power transmission systems;

*Technical note*

*'Active noise reduction or cancellation systems' incorporate electronic control systems capable of actively reducing equipment vibration by the generation of anti-noise or anti-vibration signals directly to the source.*

# Aerospace and propulsion

## System, equipment and components

1. Aero gas turbine engines.

   *Note 1 This item does not apply to aero gas turbine engines which meet all of the following:*

   *a. Certified by civil aviation authorities; and*

   *b. Intended to power non-military manned "aircraft" for which any of the following has been issued by civil aviation authorities for the "aircraft" with this specific engine type:*

   *1. A civil type certificate; or*

   *2. An equivalent document recognised by the International Civil Aviation Organisation (ICAO).*

   *Note 2 This item does not apply to aero gas turbine engines designed for Auxiliary Power Units (APUs) approved by the civil aviation authority of the Member State.*

2. 'Marine gas turbine engines'.

   *Note The term 'marine gas turbine engines' includes those industrial, or aero-derivative, gas turbine engines adapted for a ship's electric power generation or propulsion.*

3. Specially designed assemblies or components, for any of the following aero gas turbine engines:

   a. Specified above; or

   b. Whose design or production origins are either not unknown to the manufacturer.

4. Space launch vehicles, "spacecraft", "spacecraft buses", "spacecraft payloads", "spacecraft" on-board systems or equipment, and terrestrial equipment, as follows:

   a. Space launch vehicles;

   b. "Spacecraft";

   c. "Spacecraft buses";

   d. "Spacecraft payloads";

   e. On-board systems or equipment, specially designed for "spacecraft" and having any of the following functions:

      1. 'Command and telemetry data handling';

   f. Terrestrial equipment specially designed for "spacecraft", as follows:

      1. Telemetry and telecommand equipment;

      2. Simulators.

5. Liquid rocket propulsion systems.

6. Systems and components, specially designed for liquid rocket propulsion systems, as follows:

a. Cryogenic refrigerators, flightweight dewars, cryogenic heat pipes or cryogenic systems, specially designed for use in space vehicles;;

b. Cryogenic containers or closed-cycle refrigeration systems, for "aircraft", launch vehicles or "spacecraft";

c. Slush hydrogen storage or transfer systems;

d. High pressure (exceeding 17.5 MPa) turbo pumps, pump components or their associated gas generator or expander cycle turbine drive systems;

e. High-pressure (exceeding 10.6 MPa) thrust chambers and nozzles therefor;

f. Propellant storage systems using the principle of capillary containment or positive expulsion (i.e., with flexible bladders);

g. Liquid propellant injectors specially designed for liquid rocket engines;

h. One-piece carbon-carbon thrust chambers or one-piece carbon-carbon exit cones, with densities exceeding 1.4 g/cm$^3$ and tensile strengths exceeding 48 MPa.

7. Solid rocket propulsion systems and specially designed components.

8. Hybrid rocket propulsion systems.

9. Specially designed components, systems and structures, for launch vehicles, launch vehicle propulsion systems or "spacecraft", as follows:

10. a. Components and structures, specially designed for launch vehicle, manufactured using any of the following:

1. "Fibrous or filamentary materials;

2. Metal "matrix" "composite" materials; or

3. Ceramic "matrix" "composite" materials specified by 1.C.7.

11. "Unmanned Aerial Vehicles" ("UAVs"), unmanned "airships", related equipment and components.

## Test, inspection and production equipment

1. On-line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment and specially designed for the "development" of gas turbine engines, assemblies or components.

2. Equipment specially designed for the "production" or test of gas turbine brush seals.

3. Tools, dies or fixtures, for the solid state joining of "superalloy", titanium or intermetallic airfoil-to-disk combinations for gas turbines.

4. On-line (real time) control systems, instrumentation (including sensors) or automated data acquisition and processing equipment, specially designed for use in wind tunnels.

5. Acoustic vibration test equipment.

6. Equipment specially designed for inspecting the integrity of rocket motors and using Non-Destructive Test (NDT).

7. Direct measurement wall skin friction transducers.

8. Tooling specially designed for producing gas turbine engine powder metallurgy rotor components.

9. Equipment specially designed for the production of items specified by "Unmanned Aerial Vehicles" ("UAVs"), unmanned "airships and components.

## Software

1. "Software" specially designed or modified for the "development", "production" or "use" of equipment.

2. "Software" specially designed or modified to allow non-listed equipment to function as equipment specified above.

## Technology

1. "Technology" for the "development", "production" or "use" of equipment or software, specified above.